

QUALITY IMPROVEMENT The systems engineering approach to quality improvement in the NHS

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Introduction

The systems approach to problem solving, both within and outside of healthcare, has gained considerable attention in recent years, alongside the growing recognition that modern improvement challenges are seldom a linear relationship between cause and effect. Today's 'wicked problems' (a term first popularised by design theorists Rittel and Webber) are complex, interdependent and influenced by myriad levers.¹ From the level of the individual doctor–patient consultation, through to wholesale health system reform, healthcare is emblematic of the wicked problem, with policymakers, care providers and patients wading through an ever-murkier quagmire of uncertainty and unpredictability.

The systems approach posits that any complex system is organised upon numerous individuals, activities and pathways, inextricably linked to one another and, taken together, are greater than the sum of their parts. In order to make sense of, or attempt to change, any single component of the system, one must first understand its dependencies and bottlenecks. There are few industries operating with more complexity and uncertainty than the NHS, which currently faces unprecedented, existential challenges of both supply and demand: an increasingly elderly and comorbid population grappling with polypharmacy and chronic illness, our response in the aftermath of the COVID-19 pandemic and restoring elective services, and a beleaguered workforce facing acute staffing shortages. Addressing these innumerable and far-reaching pressures necessarily requires the holistic, coordinated and system-wide thinking that is central to the systems approach. The systems approach may serve to support NHS change agents in the effort to pursue healthcare's 'quadruple aim' (improving population health, reducing costs, and bettering the patient and provider experience).²

Definition

The systems engineering approach to healthcare was developed jointly between the Royal Academy of Engineering (RAEng) and

the Royal College of Physicians (RCP), and is predicated on the notion that quality improvement (QI) in healthcare should be considered through the four following lenses.

- > **People:** understanding and accommodating for user needs, preferences and capacity is essential to maximise the likelihood of sustaining and scaling change.
- > **Systems:** acknowledging the complexity of systems and the importance of iterative innovation in improving services.
- > **Design:** focusing on identifying the highest priority areas of clinical and operational need, and seeking to evaluate a range of possible solutions.
- > **Risk:** proactively identifying safety concerns and implementing mitigation strategies, while also learning from best practice.

A fifth lens, 'management', often accompanies the others, and can be understood to mean the overarching questions or principles governing the improvement process, relating to making a case for change, understanding the status quo and forecasting a future, improved state. Underpinning this framework is a process for improvement as set out in the 'Improving Improvement Toolkit' (IIT), which is, in turn, supported by a number of questions, activities and tools that are intended to crystallise the systems approach, transitioning the it from the academic to the practical. The toolkit is flexible by design, and users should select tools according to the scale and scope of their project as well as their personal preferences.

Benefits

The primary advantage of applying a systems approach in healthcare is to augment existing QI methodologies by applying activities and tools that consider key tasks and processes that may be otherwise overlooked. Thus, the systems approach should not be regarded as a *substitute* for alternative change management techniques, but should instead be seen as *supplementing* the principles contained therein; for example, a 2010 paper by Colligan *et al* demonstrated that study participants were able to identify a greater number of quality and safety concerns with a new community-based anticoagulation clinic (CBAC) when using a process map (contained within the IIT) than without using a map.³ Moreover, the systems approach may mitigate the limitations of incumbent QI methodologies (such as the Institute for Healthcare Improvement (IHI) Model for Improvement); the plan, do, study, act (PDSA) framework underpinning the IHI model has been criticised for being narrow in scope and overlooking the unanticipated consequences of change, at times causing

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greater harm than good. The systems approach acknowledges this complexity and interdependency, and advocates for a more holistic examination of the challenge at hand (eg using structured process modelling and risk management activities).

Moreover, there has long been a tendency to associate cause with effect in healthcare, despite ample evidence refuting this simple linearity. Even more developed frameworks (such as James Reasons' highly popular 'Swiss cheese model') have come under criticism in recent years for the fact that hazards seldom line up as neatly as is depicted in the model. A systems approach advocates for a yet more critical and refined analysis of a complex system by considering its components, dependencies and the rate-limiting steps precluding desired functionality.

Another significant advantage of a systems approach has been the focus on risk. Managing risk in the NHS has long been a post-mortem exercise, with a root cause analysis into reasons for failure, and a change in practice often only occurring after the fact. In contrast, one of the cornerstones of a systems approach has been to identify hazards pre-emptively, determine the likelihood of risk, estimate the severity of impact should an adverse event occur and implement mitigation strategies ahead of time. Through the use of tools such as a Failure Modes and Effects and Analysis (FMEA) and Structured What If Technique (SWIFT), each varying in their complexity, scope and contexts in which they may be applied, a systems approach facilitates a more nuanced evaluation of risk. Furthermore, a systems approach also acknowledges that positive outcomes (should) occur far more frequently than adverse outcomes and, therefore, improvement practitioners stand to learn as much, if not more, from good practice as they do from bad practice. This paradigm shift, from 'Safety I' to 'Safety II' as described by renowned systems engineer Prof Erik Hollnagel has lately been applied to many complex industries, including aviation and, increasingly, healthcare.⁴

Finally, the systems approach is inherently predicated on coproduction and stakeholder engagement. Contained within the IIT are several activities (such as ethnography and stakeholder consultations) as well as tools (such as stakeholder analysis mapping) that may serve to avoid the pitfalls of unsuccessful QI initiatives hampered by end-user disillusionment. Patients have long been neglected stakeholders in the change management process, despite the majority of healthcare QI activity targeted at improving the quality of care and the patient experience. Ill-fated improvement projects within the NHS (such as the National Programme for IT (NPFIT)) were consigned to failure in no small part due to a lack of patient and public involvement and engagement (PPIE).⁵ More optimistically, however, there is emerging evidence to suggest successful change management following a renewed emphasis on PPIE: McLaughlin *et al* observed the importance of coproduction in improving chronic kidney disease care pathways in the NHS, while O'Flaherty *et al* also advocate for stakeholder engagement in evaluating the effectiveness of the NHS Health Check programme.^{6,7}

The implementation gap

A key limitation when applying a systems approach to QI in healthcare has been to transition from a purely theoretical exercise towards real-world applicability. Despite being comprehensive in its scope, the approach is grounded in complexity and poses questions of resources, training and appetite. QI 'on the ground' is frequently the remit of time-pressured patient-facing

healthcare professionals, whose interest in and engagement with improvement activities is highly variable.⁸ Compared with the systems approach, the IHI Model for Improvement (the prevailing change model in healthcare) is based upon four key activities (PDSA), and is cognitively far simpler to understand. Even so, many critics point to apathy and disengagement with the PDSA framework as a key barrier prohibiting meaningful improvement, which may only be amplified when translated to the systems approach. Indeed, in recognition of the limited effectiveness of imposing QI on reluctant healthcare professionals, many trusts and integrated care systems (ICSs) are beginning to employ designated, near full-time equivalent QI practitioners.⁹ As such, if a systems approach is to be embedded within routine practice from the level of patient-facing staff through to national policymakers, it must be made as straightforward and digestible as possible.

To this end, the nascent study of 'implementation science' has received considerable attention of late, with many improvement experts advocating for less abstract and more practical approaches to change management.¹⁰ Clarkson *et al* acknowledge the limited real-world instructiveness of models (such as the linear improvement process model and spiral model of improvement questions) and put forward a complementary 'helical' model that combines the two, which was found to be of greater practical relevance to improvement practitioners.¹¹ Moreover, Jun *et al* observed that many change models are often conceptually similar (and the tools contained within semantically identical) and, thus, the challenge lies in providing change agents with the tools that are most usable, useful and appropriate for the given context.¹² Flowcharts, for example, were shown to be overwhelmingly user-friendly and of great instructive value in displaying a snapshot of an overall process, while the more detailed swim lane diagrams were felt to be appropriate for understanding roles and responsibilities, albeit less usable and useful than flowcharts.

Implications for policy

Alongside the systems approach, there has been a suite of related service improvement activities in recent years. Most notably, the introduction of ICSs suggests an appetite for a more coordinated and decentralised model of service delivery that is sensitive to the needs of the local population. Similarly, QI continues to be embedded within the institutional fabric of the NHS, with healthcare professionals encouraged to participate in QI activities very early in their careers. Finally, several frameworks and models have been introduced to granularly display the levels at which change must occur and which levers must align if true system-wide improvement is to be achieved. *The challenge and potential of whole system flow* report, published jointly by The Health Foundation and Advancing Quality Alliance, advocates for joined-up thinking at the levels of individual care pathways and organisations, local health and social care systems, as well as national policymaking and regulation, in order to improve flow within the health system.¹³

Fundamentally, true health system improvement can only be achieved at scale when the following dichotomy is reconciled: nurturing a genuine enthusiasm for QI among healthcare professionals while also acknowledging that wholesale improvement necessarily requires systemic change management, beyond the scope of patient-facing staff alone. Although the former may yield meaningful improvements in processes and outcomes, the fact remains that piecemeal, disconnected QI

activity perhaps represents a zero-sum game, wherein positive changes occurring in isolation beget adverse outcomes elsewhere in the system. On the other hand, overly top-down change management may also fall prey to patchy implementation, borne from stakeholder disengagement.

As such, where the systems approach is perhaps of greatest utility is in delineating the levels at which change is needed and, more importantly, the importance of aligning levers between the myriad actors present within the improvement process. The *Design for patient safety* report published by The Design Council illustrates the folly of local QI projects targeted at improving the ease and safety of drug administration, if not occurring in tandem with other initiatives, such as manufacturers being mandated to prepare safer packaging and commissioners being incentivised to purchase them.¹⁴ This example reiterates the essential importance of a joined-up and coordinated approach to QI, which is, in many ways, the bedrock of the systems approach to improvement in healthcare.

Conclusion

The NHS continues to face unprecedented challenges of supply and demand, necessitating ever more innovative and cross-sectoral approaches to problem solving. The systems engineering approach to improvement in healthcare has gained considerable attention since the turn of the millennium, and has shed light on the sheer scale, complexity and nuance in navigating the process of improvement in healthcare. At the same time, the approach is comprehensive in both its depth and breadth, and encompasses a range of questions, activities and tools designed to supplement and enhance existing change management methodologies. The systems approach acknowledges the importance of holistic change management, and the centrality of people, systems, design and risk in navigating improvement. Familiarity with the systems approach and IIT may afford change agents an entirely novel repository of tools to support their ongoing change management activities. ■

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